

Math 409, Spring 2013

Introduction to *Geometer's Sketchpad*

I'm using version 5.05 of Sketchpad for Macintosh. If you have a different version, some of the menu options may be slightly different.

Tools. On the left you will see a toolbar with an arrow, a dot, a circle, a line, a pentagon, the letter A, and several other mysterious things we probably won't use. On the top there are various menus.

Making a triangle. Highlight the *Point* tool (the dot), and put three dots in the sketch area. Go to the *Arrow* tool and highlight all three dots. Under the **Construct** menu, go to **Segment**. The dots will now be connected. You're still in the arrow tool: drag one of the dots. Drag one of the lines. Notice how the triangle deforms as you do each of these things.

Another way to make a triangle. Highlight the *Line Segment* tool. Use it to draw a segment in the sketch area. Draw a second segment from one of the points on the first segment. Connect the last two points with a third segment. Again, drag the pieces around and watch what happens.

A conjecture about triangles. Highlight three vertices, and in the **Measure** menu go to **Angle**. Do the same for the other two angles. Notice that the order you highlight the vertices matters.

In the **Number** menu, go to **Calculate**. Highlight one of the measures, type +, then the next, type +, then the next, hit =. Now deform the triangle by dragging it around. What do you think the sum of the angles of a triangle is?

Yet another way to make a triangle. Highlight the *Polygon* tool. Put the points of the triangle in the sketch area. (The trick is that you have to double-click on the last point.) You can make polygons with more sides this way too.

Constructing an equilateral triangle (SA 1). The task is to make an equilateral triangle that stays equilateral no matter what you drag. If you know how to do this, go for it! Otherwise, feel free to follow the steps below.

Open up a new sketch, and start by using the *Circle* tool on the left to make a circle. Notice that *Sketchpad* shows you two dots: the center of the circle and a dot actually on the circle. Draw another circle, centered at the second dot, that contains the first dot. (You'll have to be careful to put the mouse exactly on the dot you want to work with. *Sketchpad* will tell you that you've got the right dot by circling it in red.) Put a dot at one of the points where the two circles meet, highlight all three dots, construct a triangle from those three dots as before. Now go to the **Measure** menu and select **Lengths**. Now try dragging around the various pieces of the figure and watch what happens to the lengths.

Hiding things is crucial in *Sketchpad* constructions! Otherwise things get very messy very fast. If you want to work with an equilateral triangle but you no longer need the circles you used to construct it, you can highlight them with the *arrow* tool, go to the **Display** menu, and select **Hide**. (This menu option may show up as “Hide Circles,” “Hide Path Objects,” etc.)

You also may want to hide things so you can’t accidentally change them. For example, when you draw a circle from scratch, *Sketchpad* shows you a point on the circle. What happens when you drag the point? When you make a construction using a circle, you can hide this point so you won’t inadvertently change the dimensions of the circle by dragging it.

Circles. Here are some more useful constructions involving circles.

1. Draw and highlight two points. Choose **Circle By Center + Point** from the **Construct** menu.
2. Draw a line segment. Highlight it and one of its endpoints. Choose **Circle By Center + Radius**.
3. Draw three points. Highlight all of them. Choose **Arc Through 3 Points**. Notice that the order in which you highlight the points matters. Do this again so a different point is highlighted as the middle point.

Parallel and perpendicular lines. First play with the *Line* tool to get segments, rays, and infinite lines (when you hold the mouse down you get to choose which one). Now make some kind of line, make a point off the line, highlight both, and choose **Parallel Line** from the **Construct** menu. Again, highlight the original line and point, and choose **Perpendicular Line**. As always, drag the various pieces of your construction around and watch what *Sketchpad* does.

Tangent lines. Make a circle. Put a point on the circle (either with the *Point* tool or in the **Construct** menu). We want a line tangent to the circle through the point. But there’s no instruction for it! Ah, but we have a theorem — which you’ll prove later — which says that a tangent to a circle at a point is perpendicular to the diameter at the point. So construct the radius between the point and the center of the circle. Then construct the perpendicular to the radius through the point. Voila!

Changing appearance. Pick any construction you made, and use the **Display** menu to play with changing colors of points and lines, and line widths. Basically, you just highlight what you want to change, and then change it.

Naming. Go to the *Text* tool (the A on the side menu). Experiment with clicking on things to name them. Basically, click once and it’s named. Click again and the name goes away. Click twice very fast and you get to change the label. You need to be a little careful: if a small letter appears, *Sketchpad* thinks you’re naming a line; if a capital letter appears, it thinks you’re naming a point; if c_n appears, it thinks you’re naming a circle. So you might have to be careful where the cursor appears so you don’t name the wrong thing.

Troubleshooting. Usually when something goes wrong in *Sketchpad* it’s because you’ve highlighted too much or too little or just plain the wrong things. Sometimes it’s because you’ve highlighted things in the wrong order (e.g., **Circle By Center + Point** — the center has to come first).

A useful tip: Before highlighting things, click the arrow on a blank part of the figure. This will clear all highlighting and allow you to start from scratch.